Fragmentation of a 6-Hydroxybicyclo[3,2,1]octan-8-one

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CURRENT interest[1] in the fragmentation of 2-hydroxybicyclo[3,2,1]octan-8-ones prompts us to report a similar reaction encountered during the synthesis of modified steroids. Hydrolysis of the blocked ketone (I)† by strong base[2] afforded a mixture of two products, (II) and (III). Product (III), m.p. 165—166°, is base soluble and on the basis of spectral evidence [ν_{mull} 1720 and 1650 cm.$^{-1}$, τ − 0·11 (1H, s), 0·62 (1H, s) in $CDCl_3$, relative to Me_4Si] is formulated as shown.

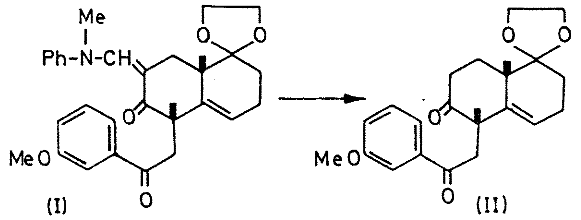
Treatment of (III) with an excess of sodium borohydride in 95% ethanol at 20° for 1 hr. gave an acidic product, m.p. 179—180°, in 91% yield; [M (mass spectrum) 414; λ_{max} (MeOH) 244 (ϵ 7420, 281 nm. (ϵ 2400); ν_{mull} 3450 (OH), 2650 (carboxyl OH), 1720 (C=O), 1650 (C=C), 1600, and 1580 cm.$^{-1}$ (phenyl); ν_{mull}(sodium salt) 1580 cm.$^{-1}$ (carboxylate anion); τ 4·21 (1H, t), 5·91 (4H, s), 6·03 (2H, s), 6·20 (3H, s), and 8·70 (6H, s) in $CDCl_3$].

Esterification of this acid with diazomethane afforded the methyl ester, m.p. 117—121° [ν_{mull} 3600 (OH), 1720 (C=O), 1600, and 1580 cm.$^{-1}$ (phenyl); τ 4·28 (1H, t), 5·93 (4H, s), 6·21 (3H, s), 6·37 (3H, s), and 8·78 (6H, s) in $CDCl_3$]. When the n.m.r. spectrum of the ester was run in $(CD_3)_2SO$ a triplet was evident centred at τ 5·57 indicating the presence of primary alcohol.[3]

Oxidation of the methyl ester with manganese dioxide gave in excellent yield an aldehyde, m.p. 120—121° [ν_{mull} 2720 (aldehyde CH), 1720 (ester C=O), and 1680 cm.$^{-1}$ (aldehyde C=O); τ 0·52 (1H, s), 4·22 (1H, t), 5·99 (4H, s), 6·18 (3H s), 6·31 (3H, s), 8·69 (3H, s), and 8·82 (3H, s) in $CDCl_3$], suggesting the alcohol is allylic as well as primary.

Based on the above evidence, a reasonable structure for the acid is (IV), the ester and aldehyde then having structures (V) and (VI).

On treatment with base, (III) is either converted into (II) (aqueous conditions) or recovered unchanged (methoxide



(I) (II)

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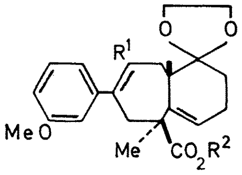
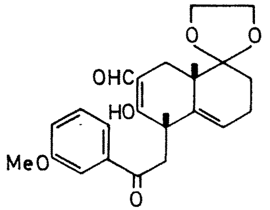


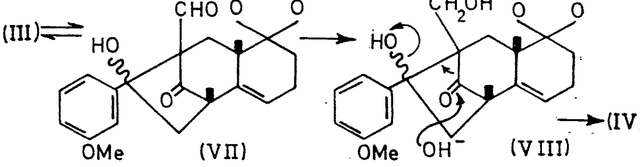
(IV) $R^1 = CH_2OH$, $R^2 = H$

(V) $R^1 = CH_2OH$, $R^2 = Me$

(VI) $R^1 = CHO$, $R^2 = Me$



(III)



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† The preparation of (I) will be described in a subsequent paper. All new compounds gave satisfactory elemental analyses.

in methanol). Addition of borohydride to (III) causes immediate evolution of hydrogen with formation of anion. The equilibrium between the anion of (III) and the ketol (VII), which must be postulated to account for the results, is effectively driven to the right by removal of (VII) from the equilibrium as its reduction product (VIII). Conversion of (VIII) into (IV) can then be rationalized by attack of base at the carbonyl carbon with synchronous fragmentation and elimination of hydroxide ion.

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[2] Y. Kitahara, A. Yoshikoshi, and S. Oida, *Tetrahedron Letters*, 1964, 1763.
[3] O. L. Chapman and R. W. King, *J. Amer. Chem. Soc.*, 1964, **86**, 1256.